

Satellite monitoring of the 2010 Russian Wildfires: Capitalizing on NASA's EOS platform and A-Train constellation



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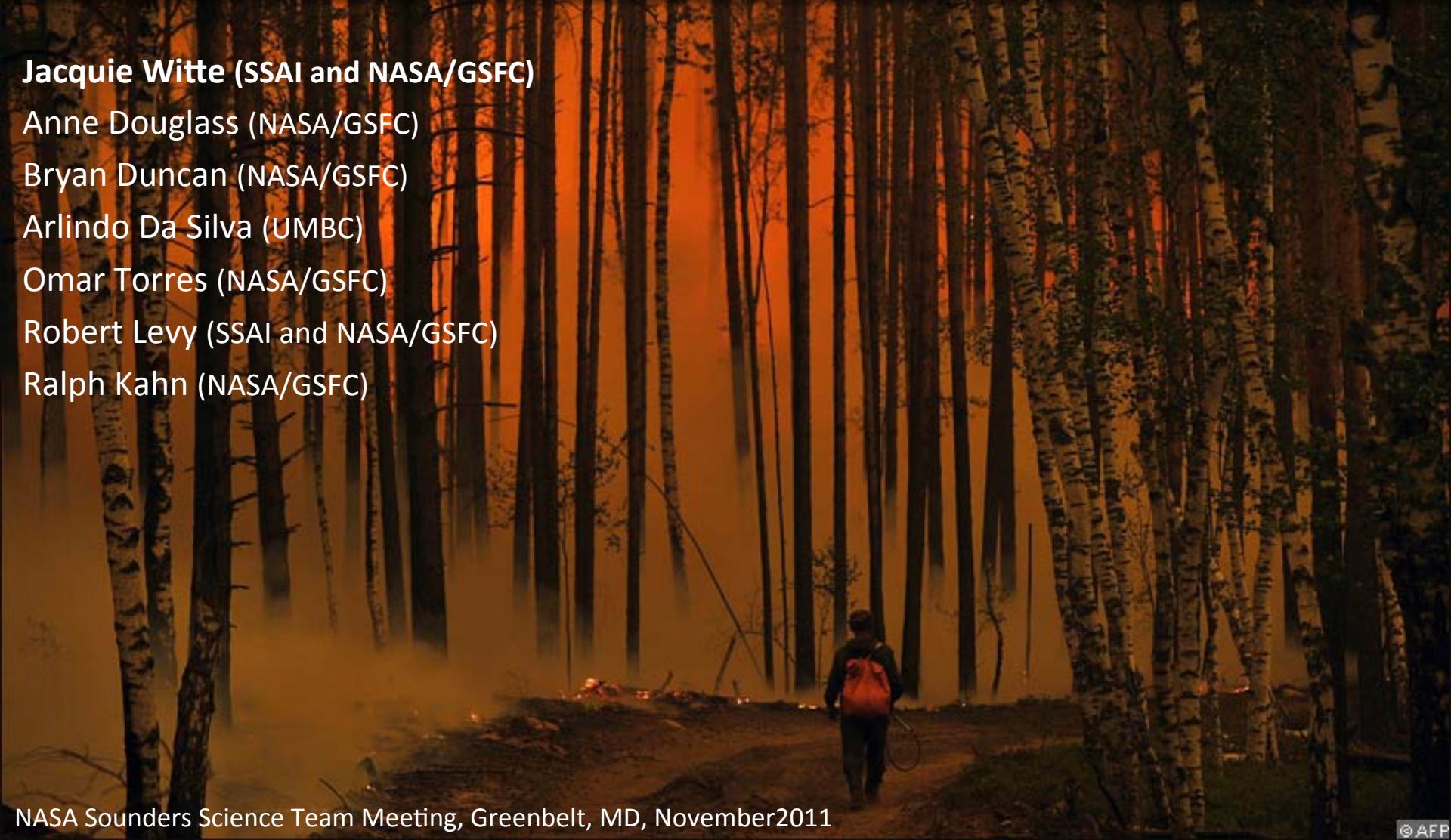
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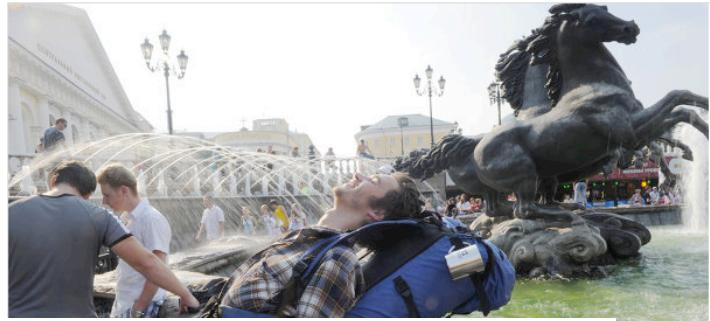
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Moscow records highest ever temperature

Topic: Abnormal hot weather in Russia



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Moscow's deadly smog returns as wildfires continue to rage

Officials record new spike in carbon monoxide levels but expect winds to reduce immediate threat

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Deadly Russian heat wave gravest over millennium

Topic: Abnormal hot weather in Russia

Heat and smog from wildfires creates health emergency in Russia

August 9th, 2010 2:12 pm ET

Record setting heat has helped fuel hundreds of wildfires across Russia in recent weeks. Now a new threat has emerged as hundreds are dying as a result of not only the fires but also the smog that has blanketed parts of the nation.



Level of Moscow air pollution exceeds norm tenfold, heat wave continues

Topic: Abnormal hot weather in Russia

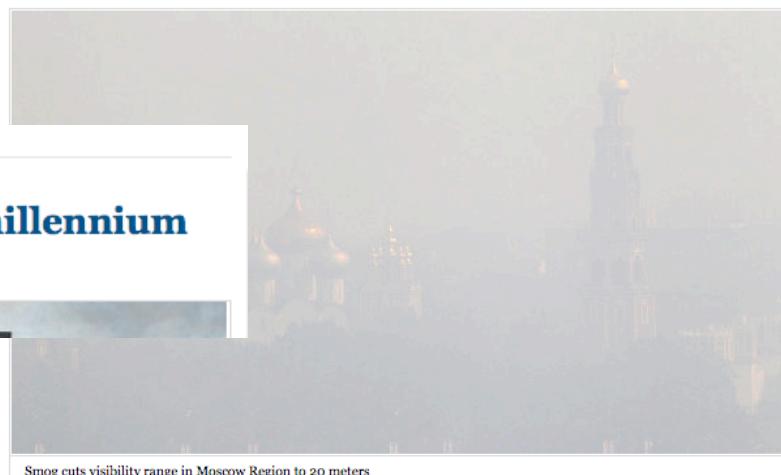
Heat and smog double death rate in Moscow

By the CNN Wire Staff
August 10, 2010 -- Updated 1048 GMT (1848 HKT)



Smog cuts visibility range in Moscow Region to 20 meters

Topic: Wildfires in Russia in 2010



Smog cuts visibility range in Moscow Region to 20 meters

12:57 04/08/2010 © RIA Novosti, Alexei Naumov

Smoke From Russian Fires Forces Flight Restrictions in Moscow

06 August 2010

VOA News

Road Map

- Satellite Instruments
- Meteorology
 - Ideal conditions for intense wildfires
 - Transport patterns: use of trajectory modeling to describe regional circulation pattern
- Regional distributions of wildfires, smoke tracers, and aerosol properties
- Smoke tracers, and aerosol properties over Moscow
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EOS/A-Train Satellite Instruments, L2 Products

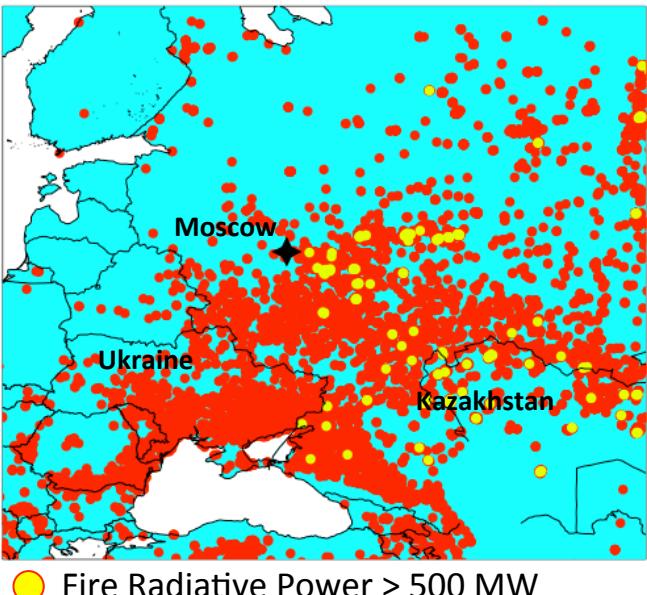


- **Aqua AIRS** (Atmospheric Infrared Sounder)
 - Total Column CO [molec/cm²]
 - Outgoing Longwave Radiation (OLR)
- **Aura OMI** (Ozone Monitoring Instrument)
 - Aerosol Index (AI)
 - Single Scattering Albedo (SSA at 388 nm)
- **Aqua and Terra MODIS** (Moderate Resolution Imaging Spectroradiometer)
 - Fire Counts and Fire Radiative Power (FRP)
 - Aerosol Optical Thickness (AOT_{.55})
- **CALIPSO CALIOP** (Cloud-Aerosol Lidar with Orthogonal Polarisation)
 - Vertical information on Aerosol content
 - Aerosol subtype, Total Attenuated Backscatter products

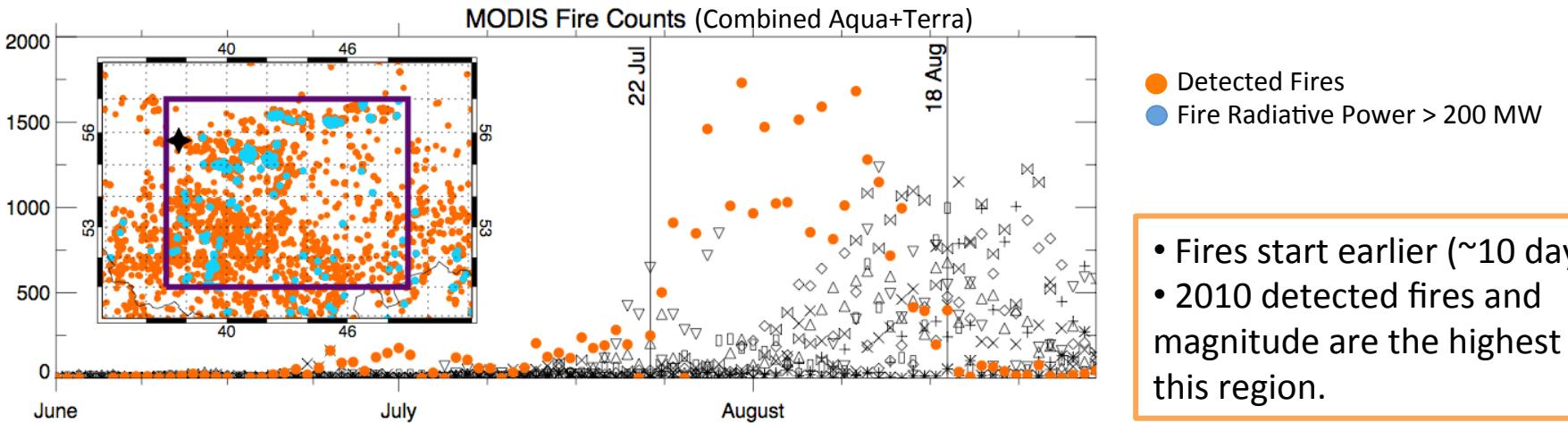
EOS/A-Train Satellite Data con't

Instrument	Versions	Overpass	Swath	Pixel / nadir	Period
Aqua - AIRS	AIRS2RET, Version 5, L2 Standard product	13:30	1650 km	45 km	2003-2010
Aura - OMI	OMAERUV, Collection 3, L2	13:30	2600 km	13x24 km ²	2005-2010
MODIS Fire products	Collection 5.1, L2 MOD14 (Terra) and MYD14 (Aqua)	Terra = 10:30 Aqua = 13:30	2340 km	1 km ²	2002-2010
MODIS AOT at 0.55 μm	Collection 5.1 L2 MYD04 (Aqua) and MOD04 (Terra)	Terra = 10:30 Aqua = 13:30	2340 km	1 km ²	2002-2010

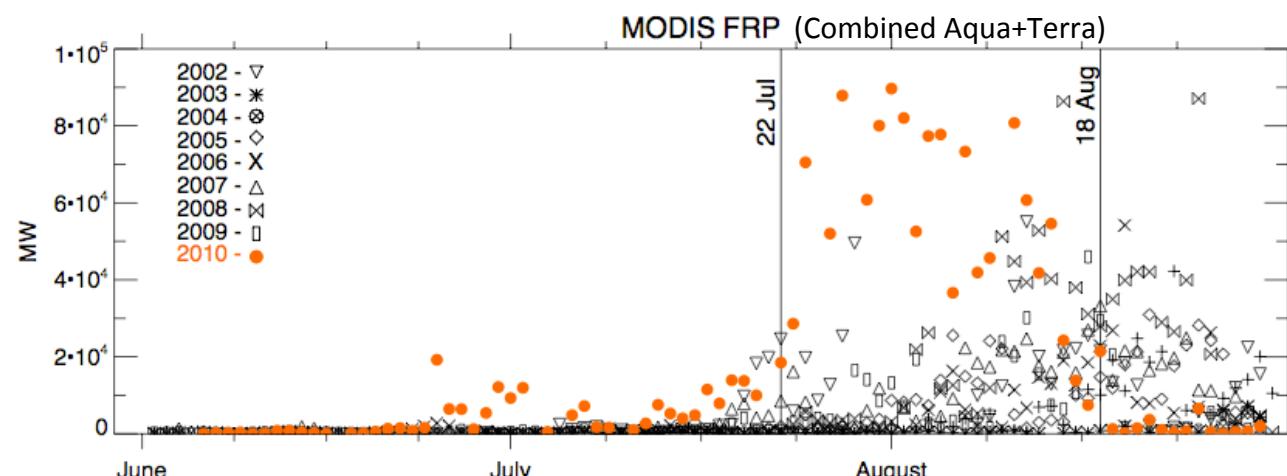
MODIS Terra & Aqua Fire Counts
August, 2010



How unique was this fire event in the satellite record?



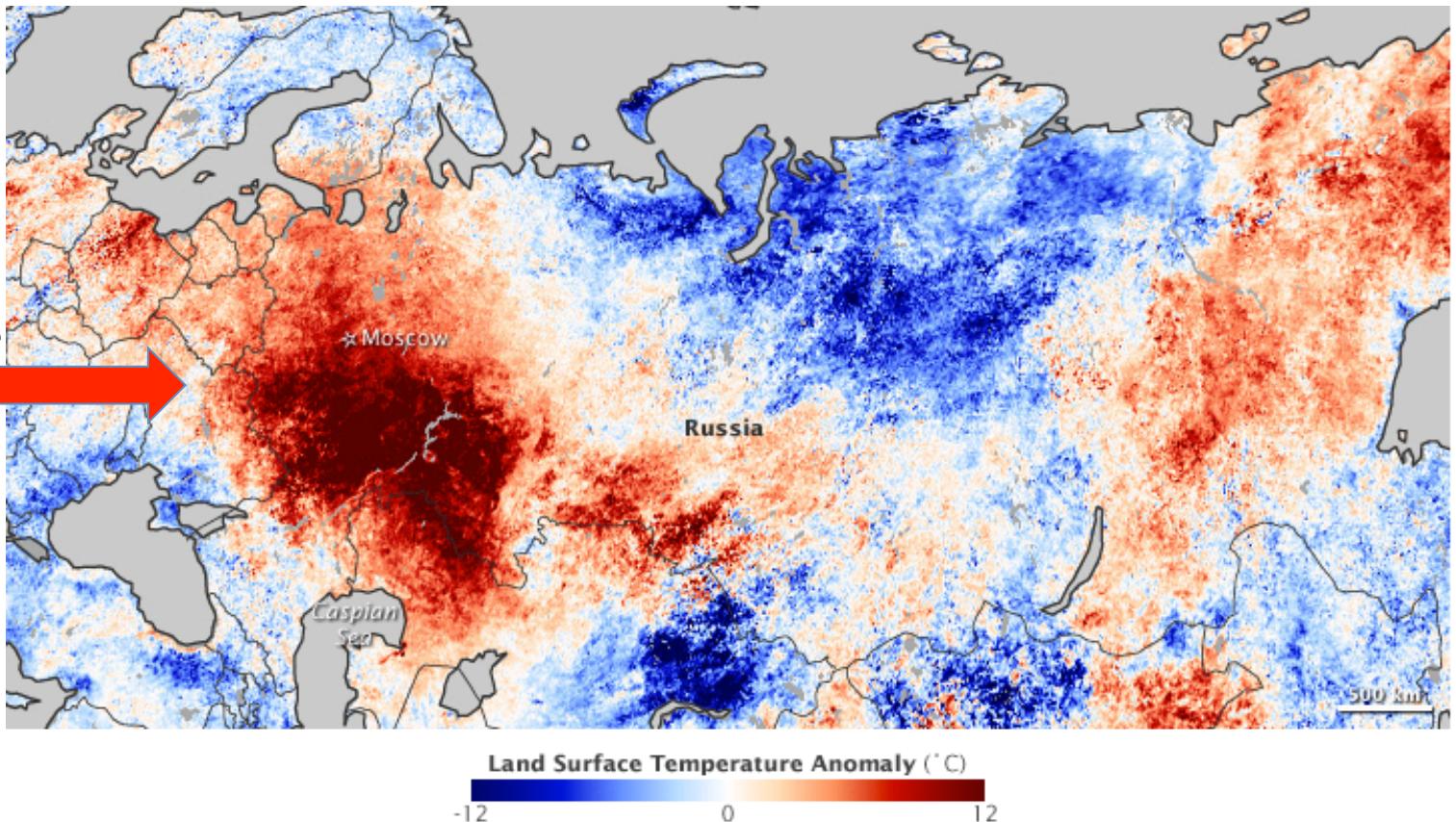
- Fires start earlier (~10 days)
- 2010 detected fires and magnitude are the highest in this region.



Meteorology – Ideal Conditions

A large-scale, stagnant weather pattern — blocking High event — developed over a high-pressure ridge above western Russia.

Above-average
Temperature



This map shows MODIS (Terra) temperature anomalies during 2nd half of July 2010, compared to temperatures for the same dates from 2000 to 2008.

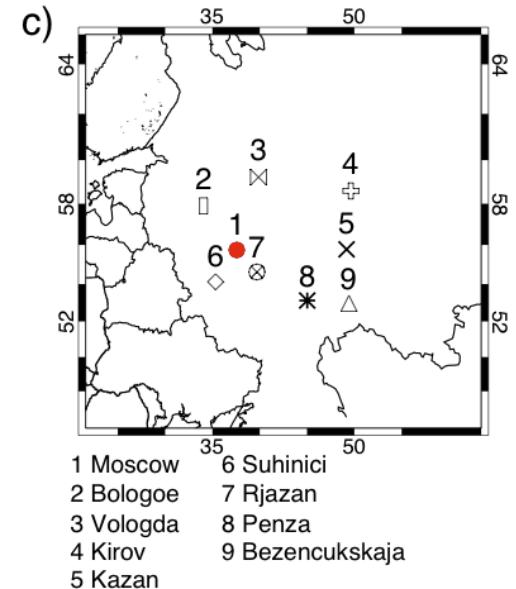
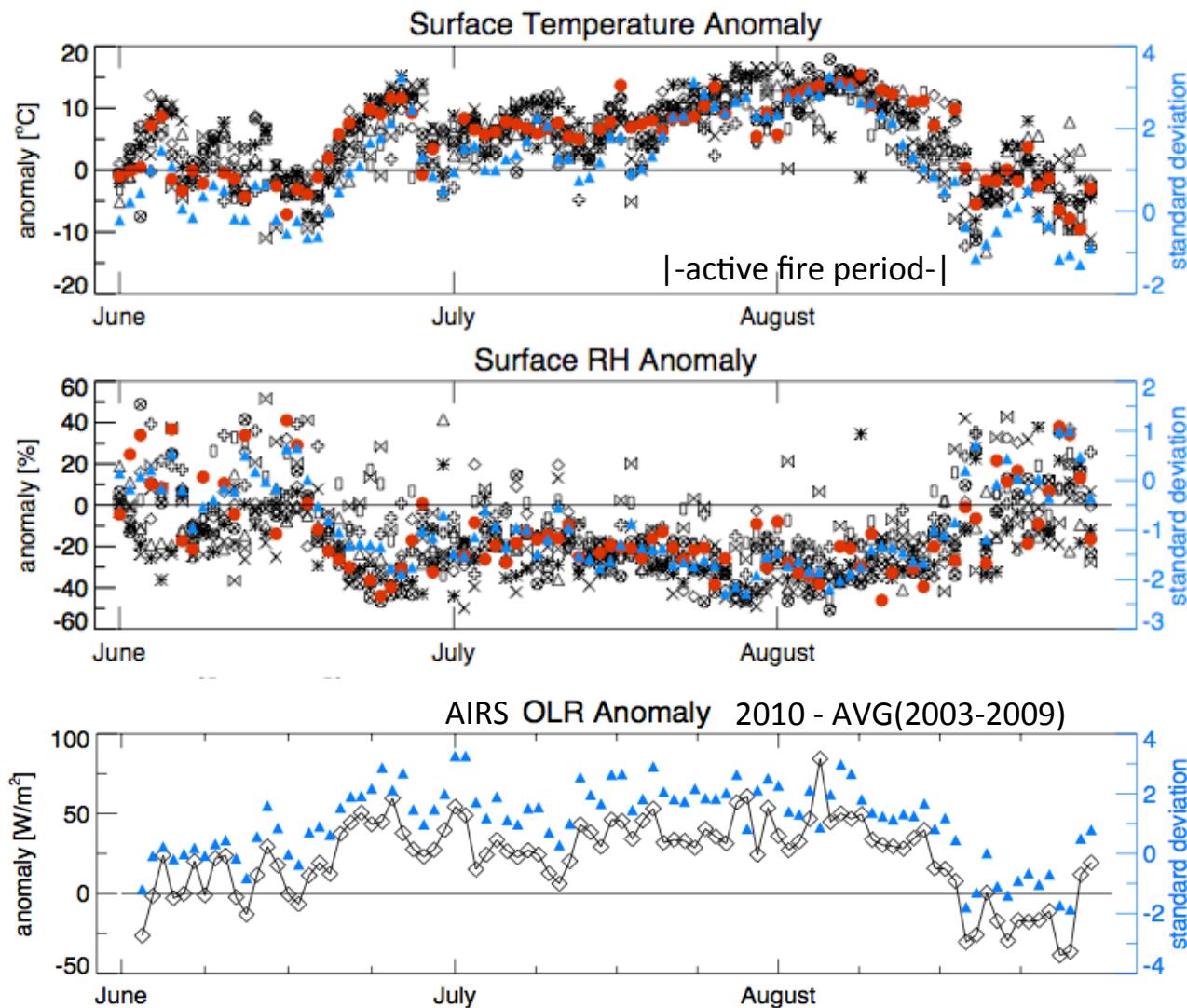
Ref: <http://earthobservatory.nasa.gov/>

Meteorology – Surface conditions



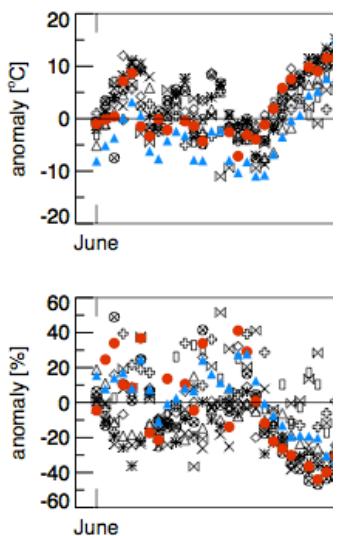
Radiosonde Data from <http://www.esrl.noaa.gov/raobs/>

Anomaly = 2010 – AVG(1994-2009)



Mean $T_{sfc} \sim 35^{\circ}\text{C} - 41^{\circ}\text{C}$
Mean $RH_{sfc} \sim 9\% - 25\%$
Mean OLR $\sim 292 \pm 15 \text{ W/m}^2$

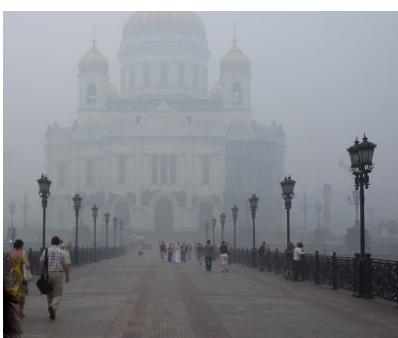
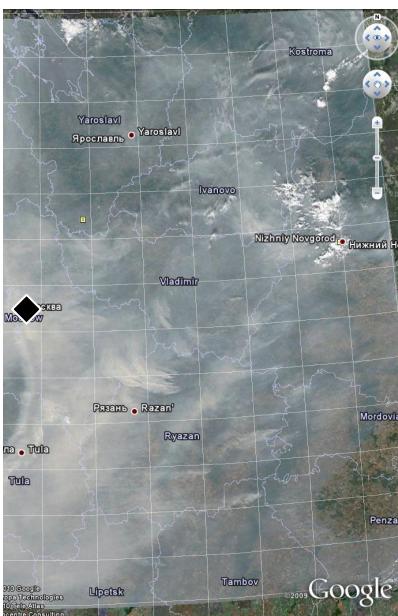
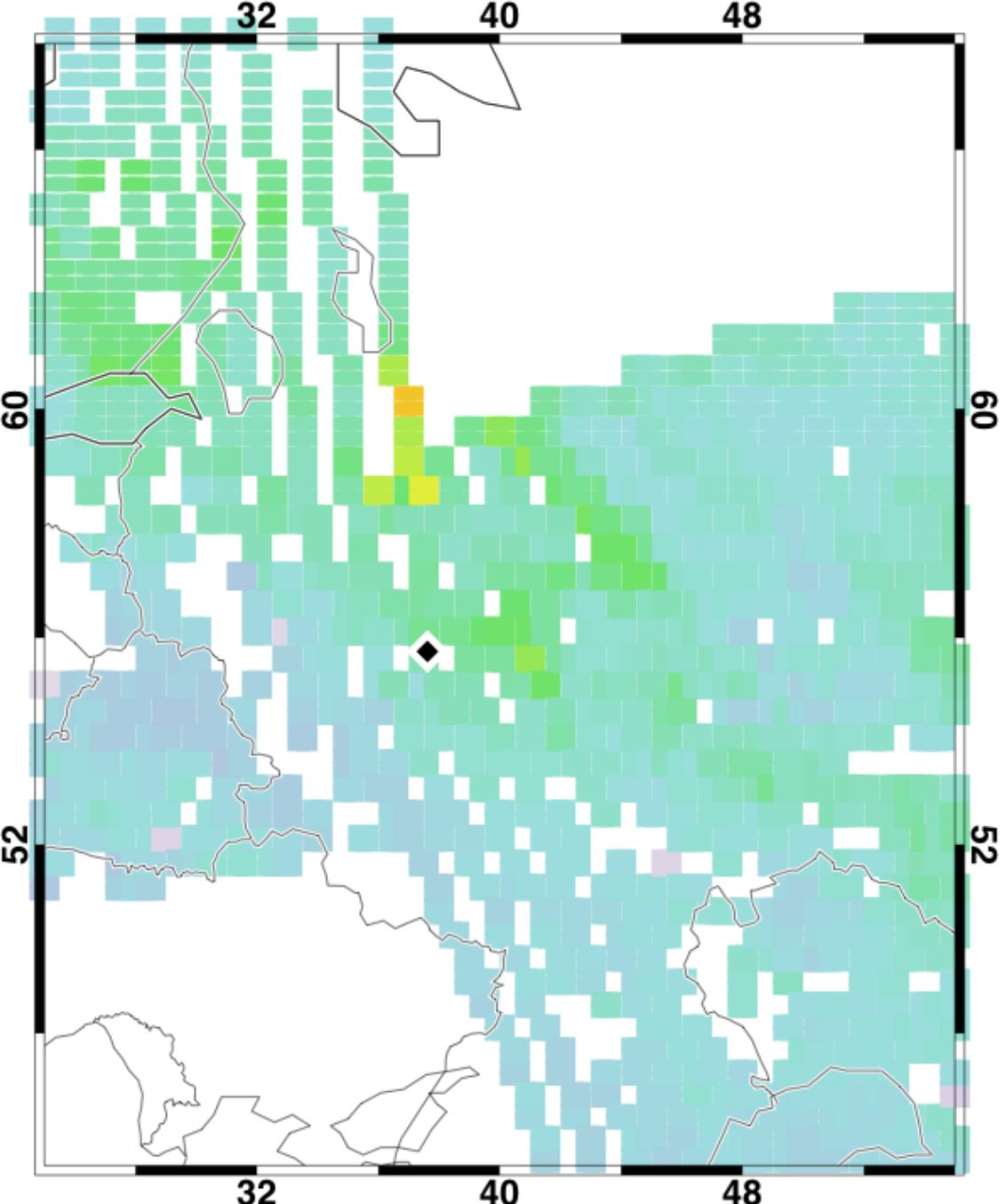
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Meteorology – Five Circulation Patterns



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2

3

4

5

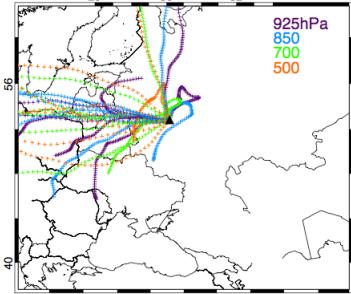
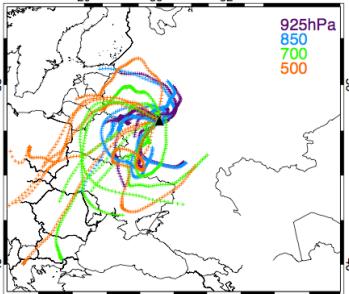
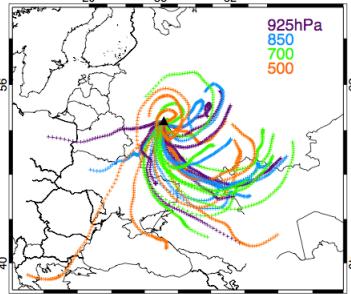
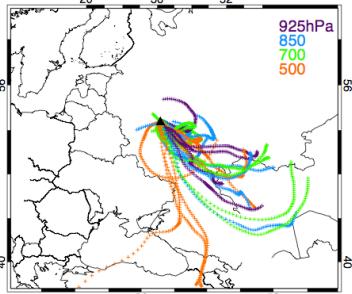
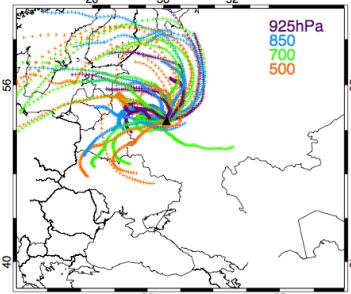
Pre-peak fires: July 11-21, 2010

July 22-29, 2010

Peak fires: Aug 1-10, 2010

Secondary Peak Fires: Aug. 11-18 , 2010

Post Peak: Aug 19-26, 2010



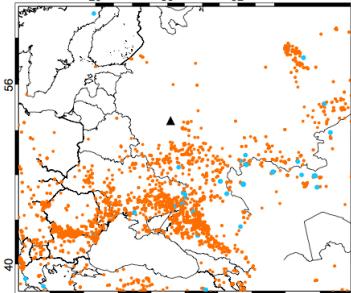
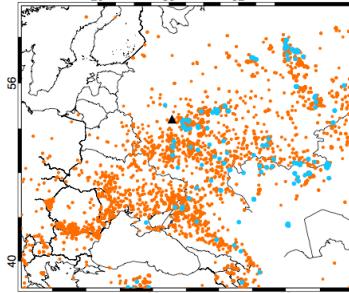
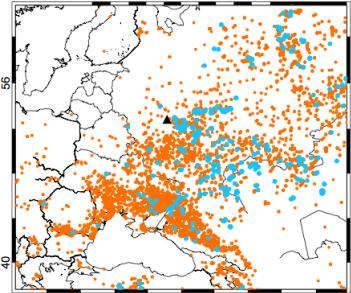
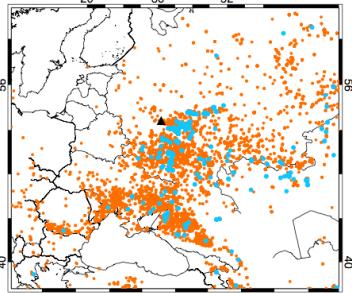
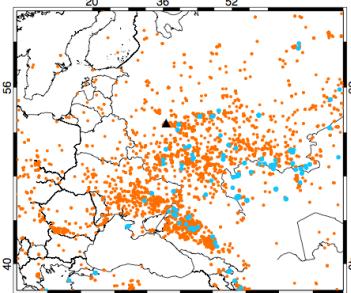
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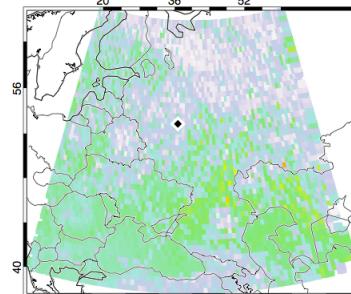
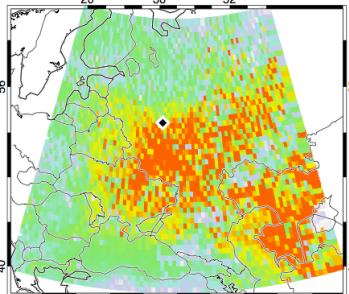
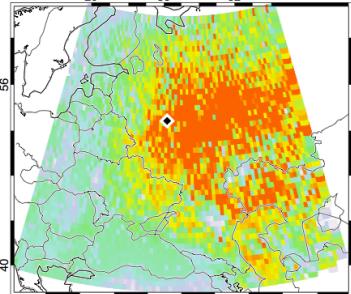
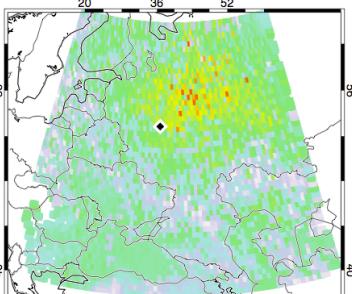
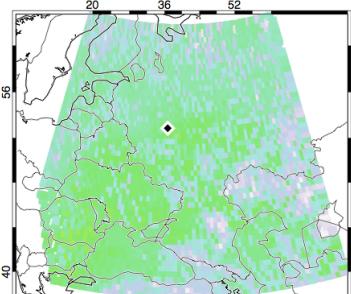
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- 3- days initialized from Moscow ($\sim 38^{\circ}\text{E}, 56^{\circ}\text{N}$)

- Pressure Levels = 925, 850, 700, 500 hPa

AIRS CO

$10^{17} \text{ molec/cm}^2$



Road Map

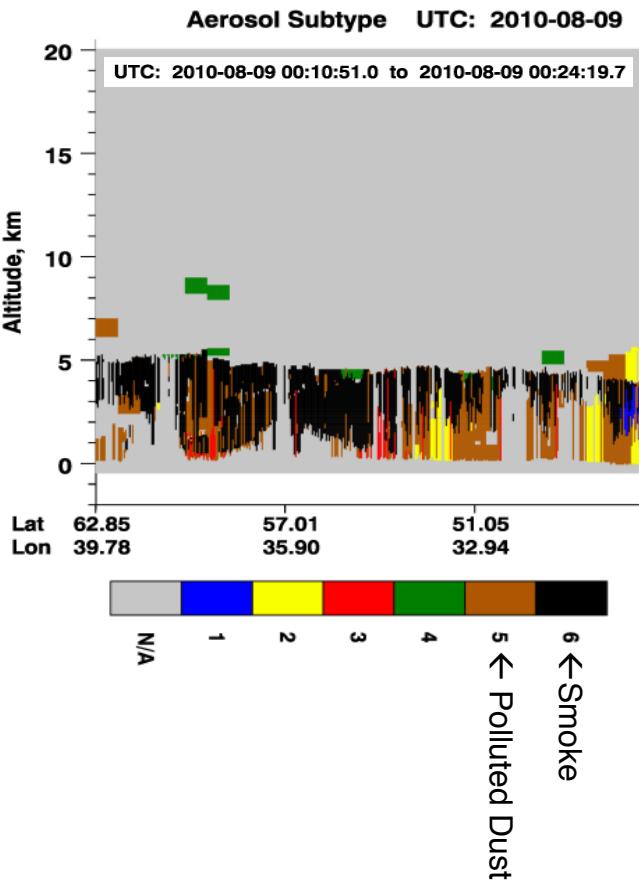
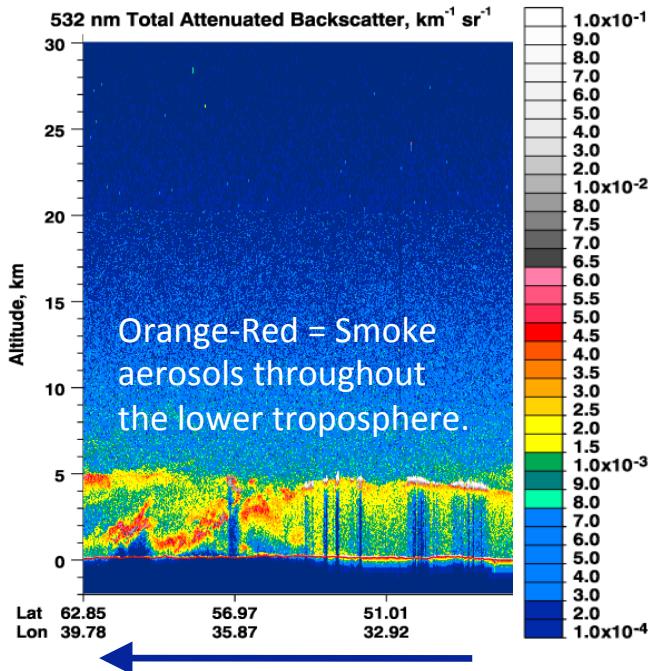
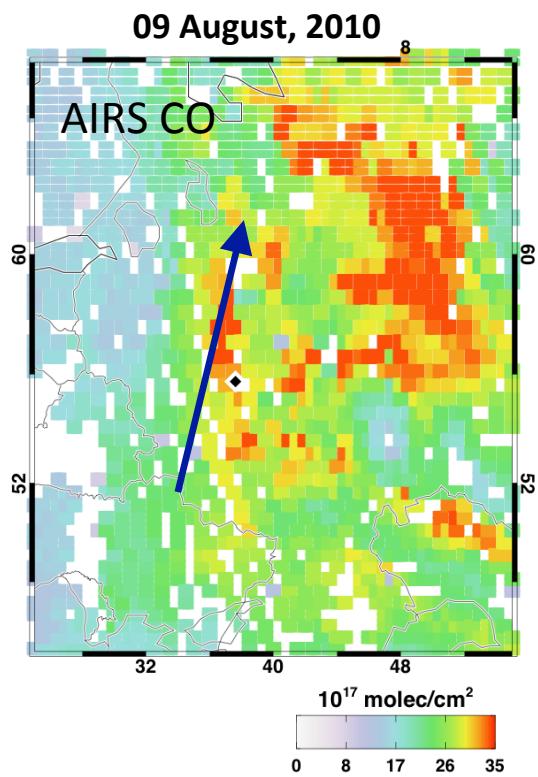
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 - Smoke Plumes and transport patterns
- **Regional distributions of wildfires, smoke tracers, and aerosol properties**
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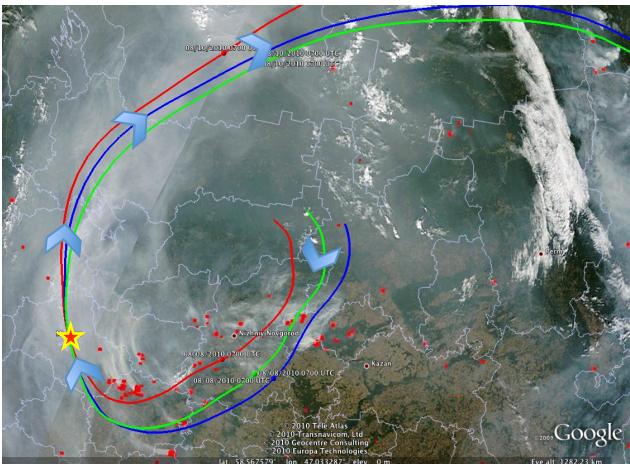
Smoke plume heights (Case: 09 August, 2010)



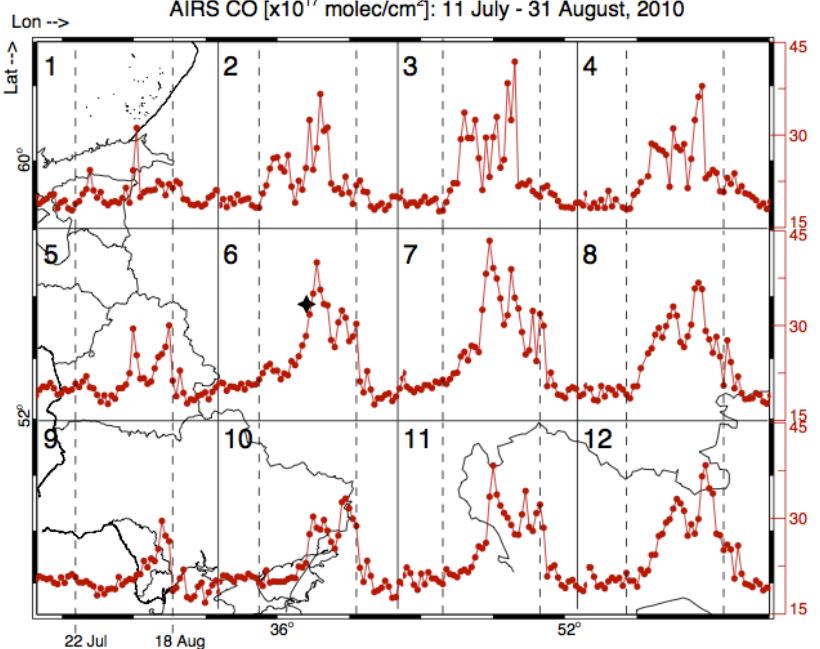
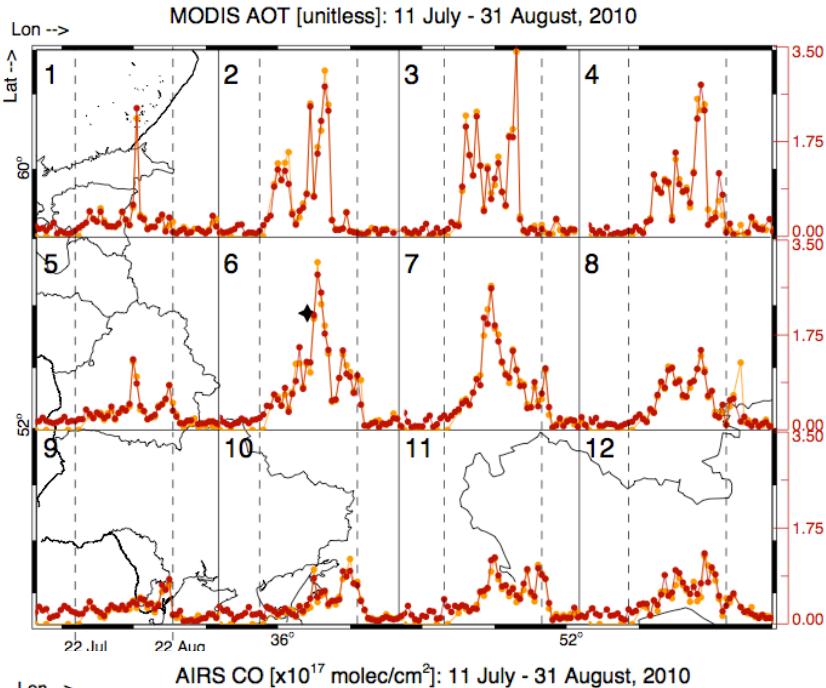
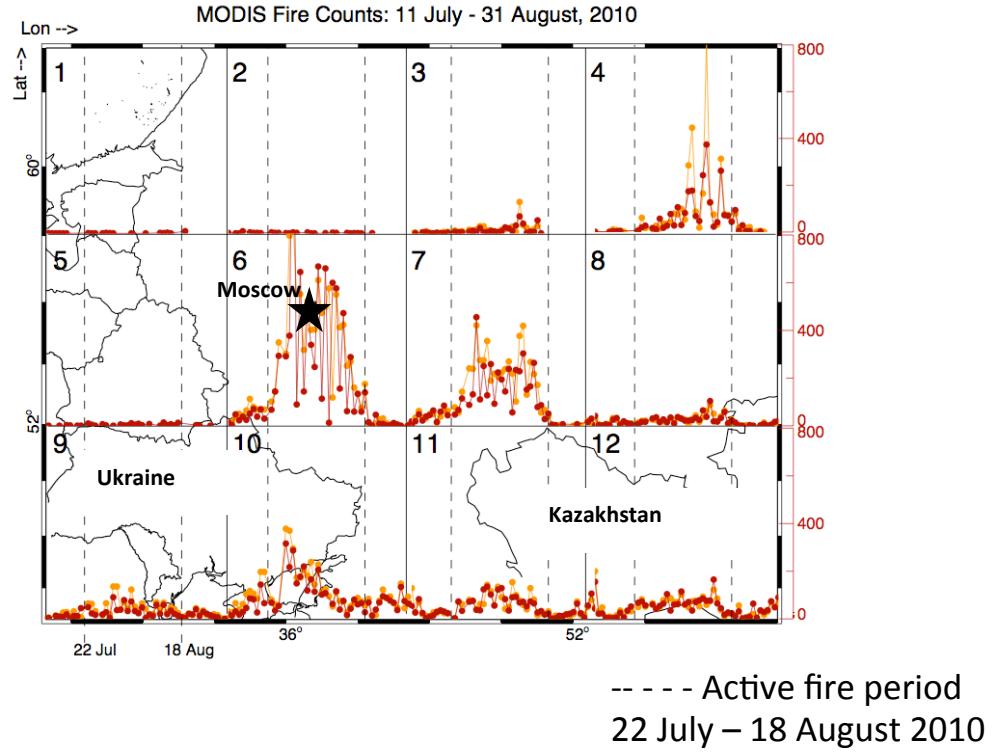
CALIPSO - CALIOP - Total Attenuated Backscatter, Aerosol Subtype



Smoke Northwest of Moscow
from fires Southeast of the city.



Regional distributions of wildfires, smoke tracers, and aerosol properties



Domain 6 (Moscow and Vicinity)

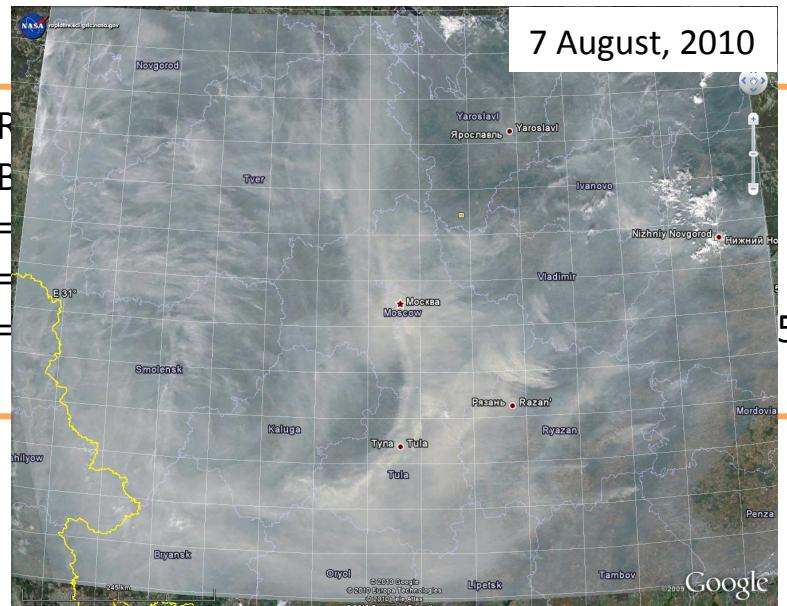
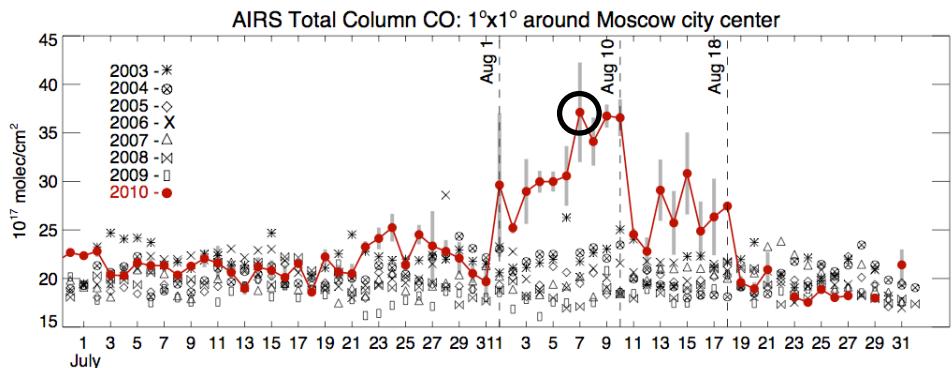
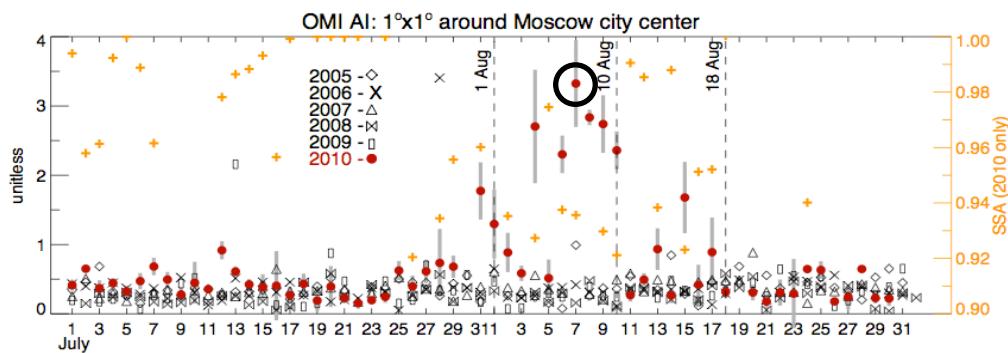
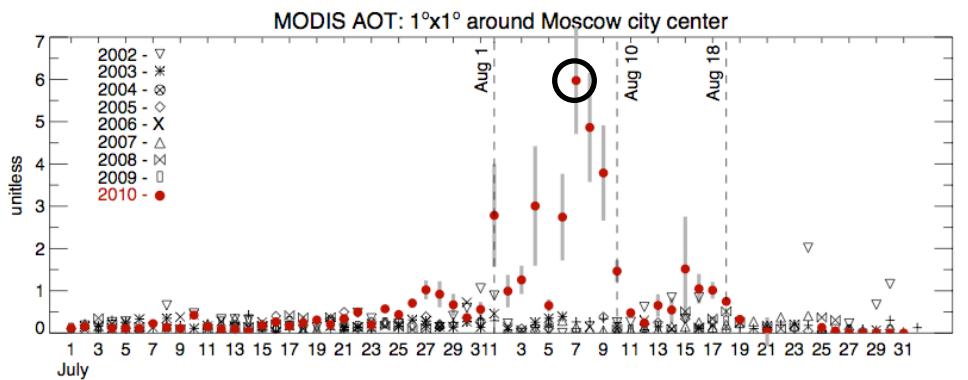
22 July – 18 August	Tracer	Factor increase
2010-mean(2003-2009)	AIRS Total Col. CO	+1.5
2010-mean(2005-2009)	OMI AI	+3.4
2010-mean(2002-2009)	MODIS AOT $_{.55}$	+6.8
2010-mean(2002-2009)	MODIS Fire Count	+8.2
2010-mean(2002-2009)	MODIS FRP	+12.0
2010-mean(2005-2009)	OMI ΔSSA of -0.05	

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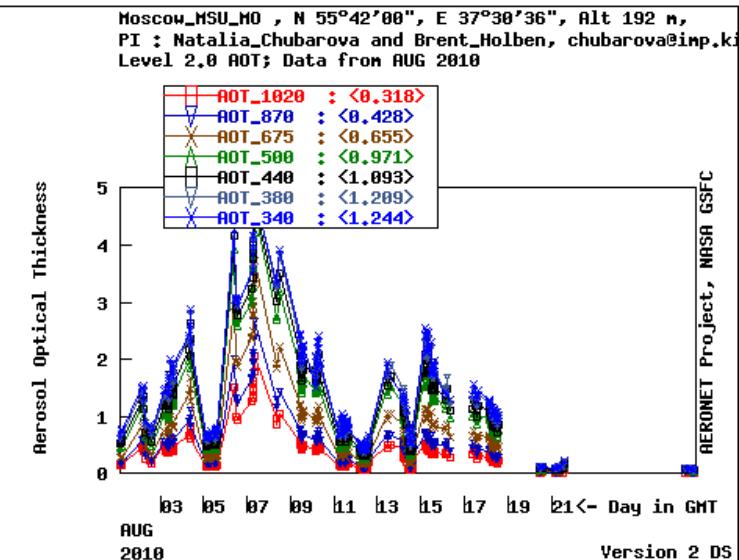
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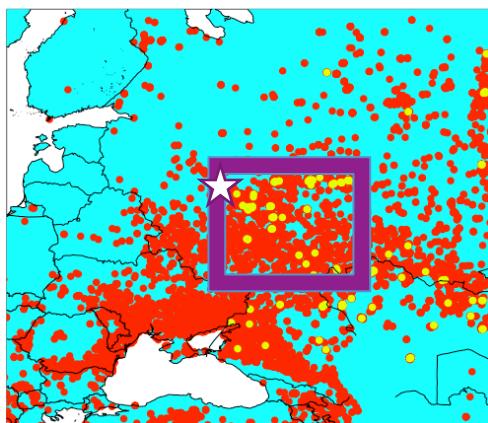
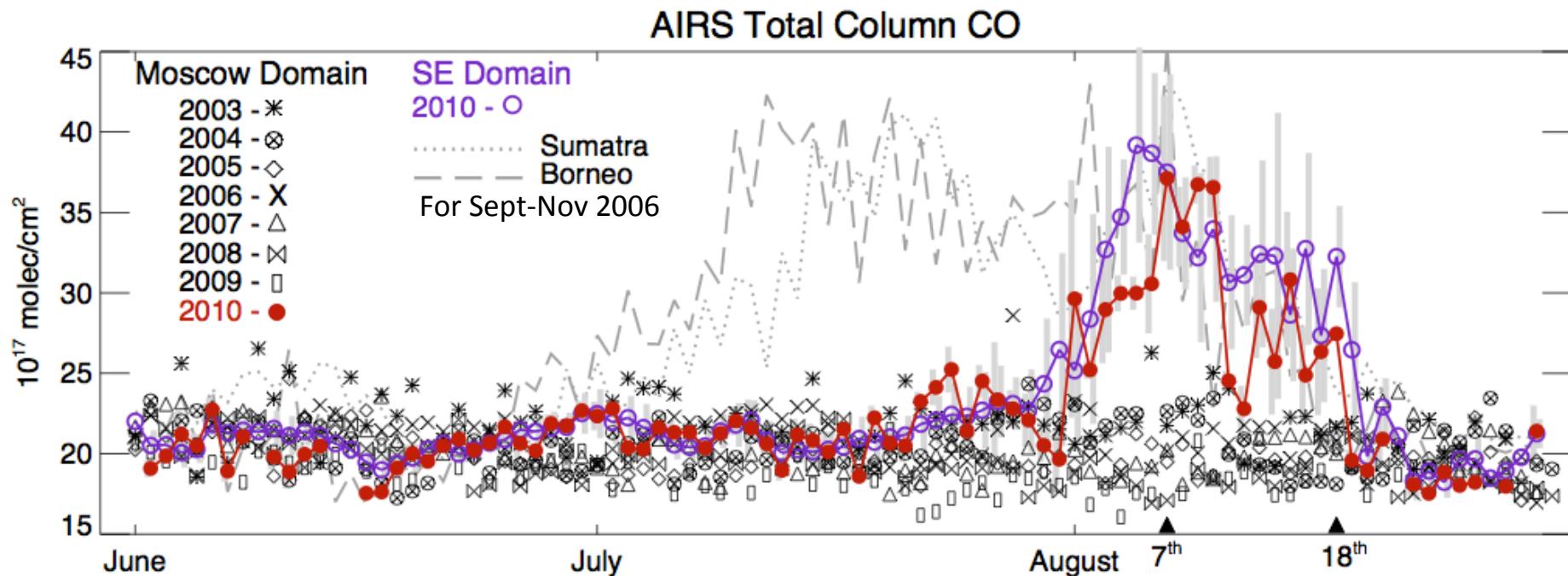
Smoke tracers, and aerosol properties over Moscow



AERONET <http://aeronet.gsfc.nasa.gov>



Compare Russian Fires with 2006 ENSO over Indonesia



MODIS TERRA & Aqua Fire Counts
August, 2010

Summary

- We describe the transport and evolution of 2010 Russian Fires using satellite observations.
 - Anomalous dry and hot weather, an untimely transport pathway associated with a persistent blocking high, and a coincident period of intense fires led to the high levels of smog and haze observed over Moscow and surrounding regions.
 - The wildfire event is unique in the historic satellite records (as far back as 2002).

